

1 [0067]

CLAIMS

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3 [0068] We claim:

1 1. An apparatus for vapor deposition of coatings having a thickness ranging from
2 about 5 Å to about 1,000Å, where at least one precursor used for formation of said coating
3 exhibits a vapor pressure below about 150 Torr at a temperature of 25 °C, the apparatus
4 comprising:

5 at least one precursor container in which said at least one precursor, in the
6 form of a liquid or a solid, is placed;

7 at least one precursor vapor reservoir for holding vapor of said at least one
8 precursor;

9 at least one device which controls precursor vapor flow from said
10 precursor container into said precursor vapor reservoir;

11 a pressure sensor in communication with said precursor vapor reservoir;

12 a process controller which receives data from said pressure sensor,
13 compares said data with a desired nominal vapor reservoir pressure, and sends a signal to
14 a device which controls vapor flow from said precursor container into said precursor
15 vapor reservoir, to prevent further vapor flow into said precursor vapor reservoir when
16 said desired nominal pressure is reached;

17 a device which controls precursor vapor flow into said precursor vapor
18 reservoir upon receipt of a signal from said first process controller;

19 a process chamber for vapor deposition of said coating on a substrate
20 present in said process chamber; and

21 a device which controls precursor vapor flow into said process chamber
22 upon receipt of a signal from said process controller.

1 2. An apparatus in accordance with Claim 1, including a device which applies heat to
2 said precursor while it is in said container, to produce a vaporous phase of said precursor.

1 3. The apparatus in accordance with Claim 1, or Claim 2, wherein a plurality of
2 precursor containers, and a corresponding plurality of vapor reservoirs are present.

1 4. The apparatus in accordance with Claim 1, wherein the following additional
2 elements are present:

3 at least one catalyst container in which said catalyst, in the form of a liquid
4 or a solid is placed;

5 at least one catalyst vapor reservoir for holding vapor of said at least one
6 catalyst;

7 at least one device which controls vapor flow from said catalyst container
8 into said catalyst vapor reservoir;

9 a pressure sensor in communication with said catalyst vapor reservoir;

10 a process controller which receives data from said pressure sensor,
11 compares said data with a desired nominal catalyst vapor reservoir pressure, and sends a
12 signal to a device which controls catalyst vapor flow from said catalyst container into said
13 catalyst vapor reservoir, to prevent further vapor flow into said catalyst vapor reservoir
14 when said desired nominal pressure is reached;

15 a device which controls catalyst vapor flow into said catalyst vapor
16 reservoir upon receipt of a signal from said process controller; and

17 a device which controls catalyst vapor flow into said process chamber
18 upon receipt of a signal from said fourth process controller.

1 5. An apparatus in accordance with Claim 4, wherein all process controllers reside
2 in a single process controller.

1 6. An apparatus in accordance with Claim 4 or Claim 5, including a device which
2 applies heat to said at least one precursor while it is in said precursor container, to
3 produce a vaporous phase of said precursor.

1 7. An apparatus in accordance with Claim 4 or Claim 5, including a device which
2 applies heat to said at least one catalyst while it is in said catalyst container, to produce a
3 vaporous phase of said catalyst.

1 8. An apparatus in accordance with Claim 4 or Claim 5, wherein a plurality of
2 precursor containers, and a corresponding plurality of vapor reservoirs are present.

1 9. An apparatus in accordance with Claim 1 or Claim 2, or Claim 4, or Claim 5,
2 wherein said coating thickness ranges from about 5 Å to about 500 Å.

1 10. An apparatus in accordance with Claim 9, wherein said coating thickness ranges
2 from about 5 Å to about 300 Å.

1 11. A method for vapor-phase deposition of coatings, where at least one precursor
2 used for formation of said coating exhibits a vapor pressure below about 150 Torr at a
3 temperature of 25 °C, the method comprising:

- 4 a) providing a processing chamber in which said coating is vapor
5 deposited;
- 6 b) providing at least one precursor exhibiting a vapor pressure below
7 about 150 Torr at a temperature of 25 °C;
- 8 c) transferring vapor of said precursor to a precursor vapor reservoir in
9 which said precursor vapor accumulates;

10 d) accumulating a nominal amount of said precursor vapor required for
11 said vapor phase coating deposition; and
12 e) adding said nominal amount of said precursor vapor to said processing
13 chamber in which said coating is being deposited.

1 12. A method in accordance with Claim 11, wherein a plurality of precursors are
2 used, and wherein a plurality of precursors are accumulated in a plurality of precursor
3 vapor reservoirs.

1 13. A method in accordance with Claim 12, wherein at least two of said precursor
2 vapors are added to said processing chamber essentially simultaneously.

3 14. A method in accordance with Claim 12, wherein at least two of said precursor
4 vapors are added to said processing chamber in sequence.

1 15. A method in accordance with Claim 11, wherein at least one catalyst vapor is
2 added to said processing chamber to facilitate vapor deposition of said coating.

1 16. A method in accordance with Claim 15, wherein said catalyst vapor is
2 accumulated in a vapor reservoir prior to transfer to said processing chamber.

1 17. A method in accordance with Claim 16, wherein said catalyst vapor is added to
2 said processing chamber essentially simultaneously with at least one of said at least one
3 precursor vapors.

1 18. A method in accordance with Claim 16, wherein said catalyst vapor is added to
2 said processing chamber in sequence with at least one of said precursor vapors.

1 19. A method in accordance with Claim 18, wherein said catalyst vapor is added to
2 said processing chamber prior to the addition of a precursor vapor to said processing
3 chamber.

1 20. A method in accordance with Claim 11 or Claim 12, wherein at least one of said
2 at least one precursor vapors is added to said process chamber from said vapor reservoir
3 more than once, by repeating steps c), d), and e).

1 21. A method in accordance with Claim 15, or Claim 16, wherein at least one of
2 said at least one catalyst vapor is added to said process chamber from said vapor reservoir
3 more than once, by repeated filling of a nominal vapor reservoir volume, followed by
4 repeated adding of said vapor catalyst to said process chamber from said vapor reservoir.

1 22. A method in accordance with Claim 11 or Claim 12, wherein a plurality of
2 precursor vapors are added to said process chamber and wherein said precursor vapors are
3 added in relative quantities required to produce coating physical characteristics.

1 23. A method in accordance with Claim 15, or Claim 16, wherein at least one
2 catalyst vapor is added to said process chamber in a quantity relative to said at least one
3 precursor vapor to produce a coating having specific physical characteristics.

1 24. A method in accordance to Claim 23, wherein a volumetric ratio of a precursor
2 to a catalyst ranges from about 1 : 6 to about 6 : 1.

1 25. A method in accordance with Claim 24, wherein said volumetric ratio ranges
2 from about 1 : 3 to about 3 : 1.